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ORIGINAL PAPER

Text Recycling in Scientific Writing

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Abstract Text recycling, often called "self-plagiarism", is the practice of reusing textual material from one's prior documents in a new work. The practice presents a complex set of ethical and practical challenges to the scientific community, many of which have not been addressed in prior discourse on the subject. This essay identifies and discusses these factors in a systematic fashion, concluding with a new definition of text recycling that takes these factors into account. Topics include terminology, what is not text recycling, factors affecting judgements about the appropriateness of text recycling, and visual materials.

Keywords Text recycling · Textual recycling · Self-plagiarism · Scientific writing · Engineering writing · Plagiarism

> I have a grant proposal that I'm ready to submit, and I would like to re-use a significant amount of the text (on the order of 5–8 pages) in a paper that I intend to submit to a journal for publication. Is this considered self-plagiarism?… Is it okay to take significant amounts of text from (e.g.) my own unpublished doctoral dissertation and use it in a grant proposal? The key issue that I am wrestling with is whether the rules are different for unpublished works like dissertations and grant proposals. (Academic Stack Exchange 2014)
>
> I am writing an article in which I need to reproduce a section of my previous paper. This section includes standard math formulations and very little text. Although I am including this section with some minor changes but [*sic*] overall structure of section would be same. I will include proper citation but

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> still I am worried if this could be a case of self plagiarism? (Academic Stack Exchange 2016a)
>
> I have just completed a Ph.D. in May and have some papers I wrote for classwork that I would like to use to write articles for submission to publications. Would this be self-plagiarism? How do I handle this? (Academic Stack Exchange 2016b)

Whether we call it self-plagiarism, text recycling, or textual recycling, the common practice of reusing textual material presents a complex set of ethical and practical challenges to the scientific community. To get a sense of these complexities, one need only examine queries on the topic posed to Academic Stack Exchange, Research Gate, or other online forums—such as those above. A casual survey of such comments shows that researchers must negotiate a wide variety of situations related to text recycling.

Ideally, scientist-authors would be able to turn to authoritative guidelines for answers to such questions. Over the past decade, increased attention to text recycling has indeed led some organizations to develop text recycling guidelines. Those who search for guidance online are most likely to land at one of these three sources:

- "Self Plagiarism" on the website of the Office of Research Integrity at the U.S. Department of Health and Human Service (Roig 2015),
- "White Paper: The Ethics of Self Plagiarism" on the Ithenticate/TurnItIn website (Ithenticate 2011), and
- "Text Recycling Guidelines" on the website of the Committee on Publication Ethics (BioMed Central/Committee on Publication Ethics 2013).

While these sources provide some guidance for dealing with text recycling in some situations, none provide substantive guidance on the concerns raised in the queries quoted above—nor on a number of other common issues faced by authors in relation to text recycling. Those who seek such guidance thus resort to online forums or personal networks, but such guidance—which is likely based on respondents' own opinions or individual experiences—is inconsistent and often contradictory. Consider the following query posted to Research Gate:

> I have a very large survey dataset and am writing two distinctively different papers from the same dataset. One more focused on policy implications and the other a more traditional academic journal article… For the most part, the methods section is the exact same, for obvious reasons. The statistical analyses differ. What do I do about the methods that are the same—survey design, implementation, etc.? I have already written a descriptive methods section and would just like to use verbatim what I wrote for the second paper but then would I have copyright issues? Is it okay to just refer my audience for the second paper to the first paper for most of the methods? (Han 2015)

Responses to this query were posted by (among others) a professor of communications working in educational administration, a professor of agronomy and horticulture, a lecturer in chemical synthesis of functional nanomaterials, and a

professor of biocybernetics and biomedical engineering. Two of these responders encourage the recycling of material from the Methods section of one paper for the other:

> I would use basically the same methods section. I have many papers with basically the same text there. If in doubt ask the editor and change at the last moment if needed.I have read quite a few excellent papers with identical methods description. There is nothing wrong in repeating this description if only you clearly state that the paper is based on the same dataset. Of course you can try rewording, but it is artificial, and if you are not a native speaker, and the original text went through the language editing, it would mean spoiling the good text.

Another responder contradicted this advice, suggesting paraphrase instead:

> If I were you, I would rewrite your methods section for your new paper. I have done this in literature reviews in which a section must say the same thing as I wrote in a previous literature review, but the wording should not be the same…

Some responders suggested another option: staggering the manuscripts and then writing an abridged Methods section for the second paper:

> You could also write a more brief version of the methods that are common to the research paper in the policy paper so that readers would know what you did, and readers that wanted more detail could also read the first paper. In your situation I would try to publish the research paper first. Once it is accepted, the policy paper can refer to the research paper for the basic methods that are shared.

But another cautioned against that approach:

> I recommend against referring readers to a different paper for the methodology. Your peer reviewers probably would not like that.

This query, and the dozens of others posted to such websites, demonstrate a need for thorough, reliable, and authoritative information on text recycling. Creating such sources, however, is not a simple task. As discussed below, text recycling involves a number of contextually-situated and interrelated ethical and practical factors. This essay is intended to further our understanding of text recycling by identifying and describing these factors, exploring the limits of current definitions, and finally offering a new definition.

About the Scope and Organization of This Paper

A Google Scholar search using the terms “text recycling” and “ethics” demonstrates that, to date, discourse related to text recycling centers on science and technical disciplines generally and research-driven scientific writing in particular. This essay thus focuses on writing within this context—including both

published genres (e.g., journal articles, conference proceedings) and workplace genres (e.g., IRB protocols, grant proposals) in fields ranging from the natural and physical sciences and engineering to the health sciences and empirical social sciences. This is not to suggest that text recycling is limited to the fields of science, technology, engineering and mathematics (frequently referred to as STEM) or to genres related to the research process. In fact, much of the discussion that follows obtains beyond the contexts discussed in this paper. However, matters within this more limited context are themselves so complex that a broader, more general discussion would be difficult without first mapping this territory. The broader discussion would also be less useful for those who are currently most interested in the topic. It is also worth noting that there exist some important issues related to text recycling in the STEM research context that are beyond the scope of the current work; these include copyright law, recycling of equations or computational coding, and cultural factors such as cultural norms and language fluency.

Even within this narrower scope, many of the relevant factors are tightly interconnected; discussing these without taking the related factors into account can be misleading in important ways. Nevertheless, each factor deserves specific attention. The approach here is to break this discussion into discrete, named sections and subsections, and then refer readers to other sections as relevant. The overall organization is as follows:

1. Terminology: *Text recycling* versus *self-plagiarism*
2. What *is not* text recycling
3. Factors affecting judgements about the appropriateness of text recycling
    (1) Characteristics of the recycled material
    (2) Context
    (3) Attribution and identification
4. Visual materials
5. Defining text recycling

Terminology: Text Recycling Versus "Self-Plagiarism"

The term "Self-Plagiarism" has often been used as a synonym for text recycling. It has been used so extensively, in fact, that when examining published guidelines and discourse on the topic, as done here, one cannot avoid dealing with the term. This term, however, poses two problems that are critically important for the project at hand.

One of these problems is the term's association with the act of plagiarism. Samuel Bruton, in his essay "Self-Plagiarism and Textual Recycling: Legitimate Forms of Research Misconduct," rehearses concerns often raised against the use of the term on these grounds (Bruton 2014). First, that the term is oxymoronic: "plagiarism" means stealing and one cannot steal from oneself. Second, plagiarism is unethical precisely because it deprives the author of credit; but for self-

plagiarism, the authors of both texts are the same person—and thus no one is harmed. Nevertheless, Bruton proceeds to argue in favor of the term:

> [F]urther reflection suggests that quick dismissals of self-plagiarism as a meaningful concept and a legitimate form of research misconduct are too hasty. Regardless of etymology and terminology, the key ethical point is that plagiarism and self-plagiarism are both wrong and wrong for largely the same reasons. Both require presenting copied material as if it was original, and in both cases, the primary offense is one of deceptively misrepresenting something as other than what it is. (Bruton 2014, p. 178)

In spite of Bruton's insistence that all unquoted reuses of text are inherently unethical, authoritative organizations including BioMed Central and COPE (BioMed Central 2013) and the American Psychological Association (2010) have all acknowledged that text recycling *is* sometimes appropriate—and in limited cases even preferred. If text recycling is *not* then inherently unethical, using a term with ethically negative connotations is undesirable and misleading. For further discussion of these issues, see Bird (2002), Bouville (2008) and Andreescu (2013).

The second problem, one which follows from the first, is that "self-plagiarism" is used in two different and incommensurate ways: Sometimes it is used as an ethically-neutral synonym for text recycling; at other times, it is a judgement-laden label for the subset of text recycling cases considered to be inappropriate. Not surprisingly, using the same term for such critically different meanings can produce confusing and even illogical results. Here are a few examples:

> "In general, most scientists would not find a problem with such text recycling, as long as new results are presented in each separate manuscript. Nevertheless, such duplication of text is a form of self-plagiarism." — Eloquent Science: A Practical Guide to Becoming a Better Writer, Speaker, and Atmospheric Scientist (Schultz 2013)

> "The terms 'self-plagiarism' and 'text recycling' are interchangeable, although nowadays the latter is more commonly used because this type of plagiarism falls within a grey ethical chasm—Not all cases of text recycling are considered acts of plagiarism." — *npj Microgravity* (Barabas 2016)

> "Self-plagiarism, also known as text recycling, is another common form of plagiarism… Although the ethical breach associated with self-plagiarism is generally less severe than with intentional plagiarism, it is still considered as scientific misconduct. Copying sections of previously published text, for example the methods section of a research paper, is occasionally legitimate…" — Indian Journal of Sexually Transmitted Diseases (Carver et al. 2011)

> "[P]lease provide transparency in the Introduction on the reuse of material to avoid the hint of text-recycling ('self-plagiarism')." — Clinical Orthopaedics and Related Research (Association of Bone and Joint Surgeons 2017)

This dual meaning presents real challenges for the present work, since for many of the published guidelines and definitions, one cannot be certain which meaning is intended. Nevertheless, each instance is interpreted here as faithfully as possible, noting any ambiguity where it seems necessary.

The problems described here suggest that we might best avoid using "self-plagiarism" in future writing as much as possible—especially in the articulation of guidelines and educational materials. Nevertheless, Bruton is likely correct in his claim that the term "has become too widespread for it to be replaced by different terminology anytime soon" (Bruton 2014, p. 177). Because "self-plagiarism" has been used so much more than "text recycling", those who seek information on the topic tend to use the former term—and the choice matters: in a current Google search with the terms "text recycling" and *guidelines*, the top five results point to the BioMed Central/COPE guidelines (BioMed Central 2013). But in a search using "self-plagiarism" and "guidelines", these guidelines do not show up even in the first ten results. In the present work, the term "text recycling" except as needed due to the use of "self-plagiarism" by those whose work is under discussion.

The term "text recycling" does, however, present one complication: What do we mean by "text"? In the fields of writing studies, rhetoric, and communication, *text* is often used to refer to an entire composition and all of its components: the work is a text, and its parts–words, photographs, diagrams, and so on—are all text. On the other hand, *text* is often used to distinguish prose from non-prose material, such as, "the text and the illustrations."

The key question here is whether "text recycling" should refer to prose exclusively, or if it should include all of the materials contained in a document. For practical reasons, the latter is used here. As explained below, in spite of some key differences, the issues related to recycling visual materials are largely the same as for recycling prose. It thus seems more useful—for authors, editors, and scholars—to group these together for general purposes. Distinctions between the two types of textual material, when needed, can by done via the unambiguous terms *prose* and *visuals.*

What Is not Text Recycling?

Before proceeding to the analysis of text recycling, it is important to identify those practices with which it might be confused or conflated. These include duplicate publication, translation, artistic repurposing, and—specific to the educational context—submitting written work for credit in more than one course.

Duplicate Publication

As discussed below in "Genre", concerns regarding text recycling are not limited to publications. Nevertheless, because published guidelines and scholarly discourse to date have focused on this context, it is important that readers not confuse valid concerns about the original content necessary for a published work with concerns about the reuse of textual material.

While opinions on the ethics of text recycling vary, there is widespread agreement within the scientific community that any manuscript worthy of

publication must offer ideas, analysis, or data distinct from any prior publications. If a manuscript submitted for publication does not contain substantively original material, we would expect it to be rejected on these grounds regardless of whether it contains recycled text. To avoid confusing matters of text recycling with those of duplicate publication, this essay proceeds on the assumption that any published paper (or manuscript submitted for publication) under consideration here would be considered sufficiently meritorious in content for its purpose.

That said, what counts as "published" is not always clear or even consistent across disciplines. For example, as Bretag and Mahmud (2009) have explained, there is ambiguity as to whether an article included in a conference proceedings should be considered as published (see "Genre" below).

In the sciences, translations may also be considered duplicate publication. In some academic fields, particularly languages and literature, translation can be one's primary type of scholarship and is recognized as such in faculty promotion and tenure decisions. In these fields a scholarly translation is an intellectual work unto itself. In STEM fields, however, translation is typically functional rather than scholarly.

Given the hegemony of English as the language of contemporary science, most translations of scientific papers are to English from other languages. Whether a scientist, engineer, or mathematician should receive any type of scholarly credit or recognition for translating a scientific paper into another language is beyond the scope of this essay. The relevant matter here is whether an author takes credit for producing multiple papers with the same content. Translations that are not recognized as scholarly work in their own right do not satisfy the test of sufficient intellectual merit described above.

Repurposing

Another practice which might be conflated with text recycling is the repurposing of text for artistic aims.[1] To understand how artistic repurposing is distinct from recycling, consider the following two examples. The first is a poem "produced" by W. B. Yeats. Yeats took a single sentence from a prose description of the Mona Lisa by Victorian literary critic Walter Pater and, by breaking up the sentence into multiple lines, presents it as a work of poetry. Here are the first four lines:

She is older than the rocks among which she sits
Like the vampire

[1] Even within the art world, however, scholars have wrestled with the issue of self-plagiarism. As early as 1984—well before concerns about text recycling were widespread in the sciences—philosopher David Goldblatt published, "Self-Plagiarism," an essay that asks whether new works by an established artist that closely follow the artists established style without adding new artistic ideas can legitimately be called works of art (Goldblatt 1984). "Self-plagiarism," writes Goldblatt, "occurs when the artist takes from the aesthetically significant features of his/her previous work, and presents them under the false assumption that they are creatively original and that aesthetic progress has been made, while the successful self-plagiarism is received, discussed and evaluated by artworld members as if it were." The artistic sensibilities of repurposing from others as contrasted with recycling one's own material may best be understood by these words of Picasso: "We must pick out what is good for us where we can find it- except from our own works. I have a horror of copying myself." (Goldblatt 1984, p. 71).

She has been dead many times
And learned the secrets of the grave

According to Jason Guriel, Yeats' artistic aim in constructing this "recontextualization" was "bringing something beautiful to the reader's attention, of trying to train our attention on the poetic possibilities of the language he had recovered and made strange" (Guriel 2015). A more recent and rather controversial act of recontextualization is Kenneth Goldsmith's "The Body of Michael Brown." Goldsmith's poem consists in its entirety of the autopsy report of the teenager fatally shot in 2014 by Ferguson police officer Darren Wilson, to which Goldsmith made only minor alterations. Goldsmith himself explains his art this way: "I don't write anything new or original. I copy pre-existing texts and move information from one place to another." (Goldsmith 2013).[2]

The key distinctions between recycling and repurposing are familiarity and context. For the kind of repurposing exemplified above to succeed artistically, the new context must be sufficiently distinct from that of the source to allow the audience to recognize the contextual shift. In contrast, text recycling makes sense only when the context and function of the new text are sufficiently similar to that of the source text—so that the source material is equally effective in the new context. If the context of the new work is not sufficiently similar, the rhetorically appropriate decision would be to rewrite (paraphrase) the material to make it fit the new context.

Coursework

Given the concerns raised above regarding the use of "self-plagiarism" as a synonym for text recycling, it is unfortunate that "self-plagiarism" and "text recycling" are also used as synonyms in naming a rather different practice: students submitting work for credit in one class for which they have already received credit in other. For example, the Marymount University Community Standards contains the following entry:

> Text-recycling or self-plagiarism: The submission of work to meet the requirements of one assignment when it was done in whole or in part to meet the requirements of another assignment, exercise, or similar academic purpose, unless approval to do so has been granted by the instructor. (Marymount University 2016)

The concerns raised in this and similar documents involve the awarding of educational credit. A number of studies addressing these concerns have been published by Halupa (2014) and Halupa and Bolliger (2013, 2015). Those in educational settings should be careful when making or interpreting policy not to confuse these concerns with text recycling as discussed in the present work.

[2] This type of artistic recontextualization is distinctly different from that described by Yongyan Li in 'Standing on the Shoulders of Giants': Recontextualization in Writing from Sources (2015). Li uses the term to describe how an experienced scientist reframes citations from reference lists of other authors to fit his or her own work.

Factors Affecting Judgements About the Appropriateness of Text Recycling

While it might not be immediately apparent, many factors can be relevant in determining whether or not specific instances of text recycling are appropriate. To help us understand these factors, we might categorize them into three groups: (1) those related to the characteristics of the recycled material (such as its quantity); (2) those related to the context in which the recycling occurs, such as authorship; and (3) those related to attribution and identification, such as whether the recycled material is cited.

Characteristics of the Recycled Material

Text recycling guidelines frequently address two factors which can be observed within the text itself: how much material is recycled and where in the manuscript that material is placed. Also important but infrequently addressed are the rhetorical purpose of the recycled material and the extent to which the material is dispersed within a document.

Quantity

Quantity of recycled material is often taken to be a primary factor in determining the acceptability of recycling in a manuscript. For instance, when editors of the *Journal of General Internal Medicine* conducted perhaps the first poll about recycling in 2010, a primary finding was about quantity. They reported that many experts "are fine with around 10% re-cycling of verbiage… a few suggested limits of 15–20%, but none countenanced more than 30%" (Kravitz and Feldman 2011, p. 1).

Guidelines for text recycling often refer to quantity as a factor that needs to be considered when adjudicating cases. However, organizations issuing guidelines have generally refrained from establishing specific numerical thresholds (see, for example, Bird and Sivilotti 2008), relying instead on references to quantity in terms of vague binaries or unspecific thresholds. The BioMed Central guidelines, for example, state, "When *significant overlap* is identified between two or more articles, editors should consider asking for clarification and/or taking action" [emphasis added] (BioMed Central 2013). Similarly, the American Psychological Association Guidelines state that the need to cite recycled material is contingent on whether the amount of material is "limited in scope" or "more extensive" (American Psychological Association 2010). Such ambiguity, of course, leaves it to editors to adjudicate each case individually and makes it difficult for authors to know how much text they can in fact recycle.[3]

[3] These examples also show that judgments about some factors cannot be readily decoupled from others.

Structural Location and Rhetorical Function

Text recycling guidelines often note that the acceptability of recycled text depends in part on the location of the recycled material within the manuscript—almost always in the context of the standard IMRaD (Introduction, Methods, Results and Discussion) format of the empirical scientific research report. The Biomed Central/COPE guidelines (BioMed Central 2013) refer to this as "where in the article the text recycling occurs." Structural location matters to STEM authors and editors because different sections of IMRaD papers generally contain content with different levels of scientific importance. While the Methods section of such papers is important for establishing that the research process is trustworthy and reproducible, the Results and Discussion sections contain the material most essential to the intellectual contribution of the work. Researchers might use a method quite similar to one used in a prior study, but the data collected (or computed) and the interpretation of those data must be in some way original to justify publication. This is why guidelines often make exceptions for recycling in Methods sections or in the literature review part of the Introduction while having more restrictive policies about Results and Discussion sections.

Framing these concerns in relation to structural location is, then, logical. Yet location is only a proxy for the real matter of concern: rhetorical function. This difference is made clear in the BioMed/COPE guidelines, in which the section titled Introduction/Background draws distinctions among the different kinds of material typically included in an Introduction section:

> Some degree of text recycling in the background/introduction section of an article may be unavoidable, particularly if an article is one of several on a related topic. Duplication of *background ideas* may be considered less significant or even considered desirable, contrasted with duplication of the *hypothesis*, which will only be appropriate in very closely related papers. [emphasis added]

Similarly, while much of the material in a Methods section may be descriptive, these sections may also include passages justifying the chosen method. Guidelines and policies for text recycling practices may be more useful if they move beyond simple considerations of location to include discussion of the rhetorical aim of the various materials within any given section.

Distribution of Material

Unlike quantity or location/rhetorical function, guidelines for text recycling rarely if ever address the way in which recycled material is distributed *within* any particular section. While the pattern of distribution may not be important in and of itself, it has indirect relevance. Some published opinions on text recycling practices argue that authors should explicitly quote themselves rather than recycle material (see, for example, Lowe 2003). This position appears to be based on the tacit assumption that such material will occur in only a very small number of contiguous chunks—for which the use of quotation marks as identifiers might be tolerated by a scientific

readership (see "Attribution and Identification"). However, while empirical studies on such patterns have yet to be published, a casual survey suggests that the distribution of recycled material is often more diffuse, which would result in large numbers of quotation marks and so might not be acceptable.

The distribution of recycled material—whether it occurs in a single, easily-demarcated chunk or in distributed passages interwoven with new material—may be relevant in determining whether specific expectations or methods for citation or identification are tenable.

Context

The factors discussed in the section above are characteristics of the recycled material itself; other relevant factors have to do with the context in which the recycling occurs. Such factors include authorship of the source text and the new work (and what constitutes authorship in each context), what kinds of writing are involved, and whether any of the authors is a student.

Authorship

The concept of one's "own" writing is central in any discussion of text recycling. After all, this is what distinguishes text recycling from quotation or plagiarism. But what precisely does it mean? The concept has been extensively problematized in the scholarly literature on plagiarism (see for example Howard 1995, 2000; Haviland and Mullin 2009; Lyon 2009). This line of scholarship raises compelling questions about the communal nature of writing and the extent to which any writing can be truly original. But aside from these concerns, a robust consideration of text recycling as related to scientific and technical writing must address the matter of plural authorship.

While single-authored texts may remain the norm in the academic humanities, the vast majority of academic, professional, and technical writing in the twenty-first century is multi-authored. In social science fields, research articles routinely have more than three authors. In health sciences, a dozen or more authors is not uncommon. And in the field of particle physics, contemporary conventions for authorship have resulted in notably longer author lists:

> [I]n particle physics, hundreds of researchers may contribute to the development and maintenance of a single piece of equipment, such as an accelerator. At big physics labs such as CERN, everyone who was working at the lab when the discovery was made gets a slot on the author list. (Dance 2012)

The current record for most authors on a single paper as of this writing is held by an article published in *Physical Review Letters* in 2015 at 5154 (Aad et al. 2015). This dramatic increase in the number of authors listed for scientific papers has indeed

raised difficult questions about the very nature of authorship.[4] We live in a time in which multiple authorship is the norm in most scientific fields, and yet text recycling guidelines and discussions rarely even acknowledge plural authorship, let alone address essential authorship-related issues.

To explore the ways in which plural authorship complicates decisions about text recycling, consider a 2011 article published in the *New England Journal of Medicine*. This is one in a series of articles reporting on research for the RTS,S (trade name Mosquirix) malaria vaccine. The first page of this article, shown in Fig. 1, clearly presents the work as the product of a research team rather than individual authors. (Note highlighted text.)

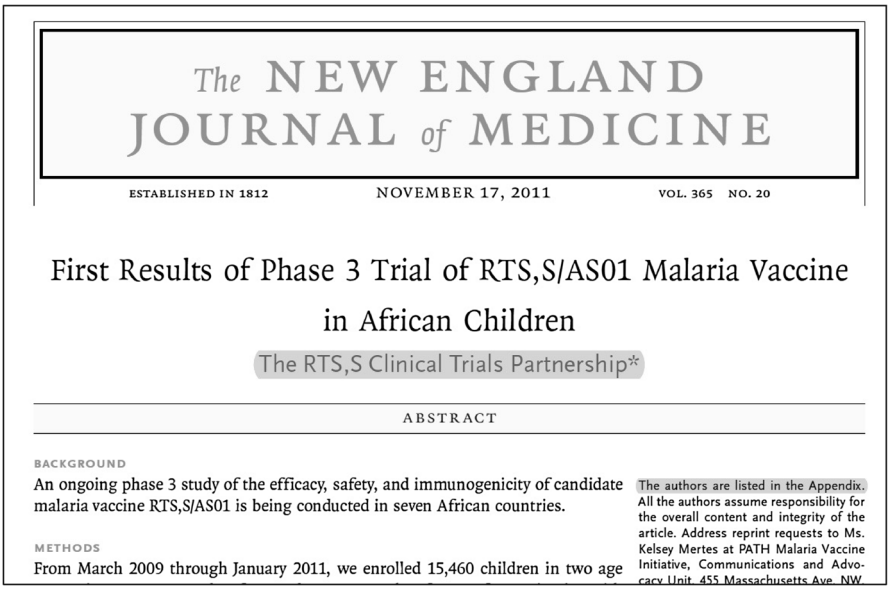
In the space below the title where we would traditionally expect to see the authors' names, we see only the name of the research group: the RTS,S Clinical Trials Partnership. As noted on the lower right in this figure, the authors' names are relegated to an appendix, shown here in Fig. 2.

Work on the RTS,S vaccine has spanned decades. This is not unusual in the world of medical research, where the standard protocol for conducting experiments of new medications on humans ("clinical trials") is to do research in a series of "phases" to minimize risk along the way. Early research in RTS,S began in the 1980s, but not until 2009 had the development advanced to the stage where clinical trials could begin. Between 2011 and 2014, four articles reporting on the increasingly expansive human trials were published in leading medical journals under the authorship of the RTS,S Clinical Trials Partnership:

> First Results of Phase 3 Trial of RTS,S/AS01 Malaria Vaccine in African Children, *New England Journal of Medicine* (RTS,S Clinical Trials Partnership 2011)
>
> A Phase 3 Trial of RTS,S/AS01 Malaria Vaccine in African Infants, *New England Journal of Medicine* (RTS,S Clinical Trials Partnership 2012)
>
> "Efficacy and safety of the RTS,S/AS01 malaria vaccine during 18 months after vaccination: a phase 3 randomized, controlled trial in children and young infants at 11 African sites," *PLoS Medicine* (RTS,S Clinical Trials Partnership 2014)
>
> Efficacy and safety of RTS,S/AS01 malaria vaccine with or without a booster dose in infants and children in Africa: final results of a phase 3, individually randomised, controlled trial, *The Lancet* (RTS,S Clinical Trials Partnership 2015)

It is important here to recognize that the medical research community *expects* researchers to share their findings at each stage of such a research project, and this means multiple, closely-related publications. Many important technical details—how the vaccine was administered, how cases of malaria were clinically determined, and so on—are essentially the same from one clinical trial to the next, so there would seem to be legitimate reasons why authors might choose to recycle some

[4] Jason Borenstein and Adil Shamoo have given a useful overview of issues related to the growing number of authors per paper (Borenstein and Shamoo 2015).



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First Results of Phase 3 Trial of RTS,S/AS01 Malaria Vaccine in African Children

The RTS,S Clinical Trials Partnership*

ABSTRACT

BACKGROUND

An ongoing phase 3 study of the efficacy, safety, and immunogenicity of candidate malaria vaccine RTS,S/AS01 is being conducted in seven African countries.

METHODS

From March 2009 through January 2011, we enrolled 15,460 children in two age

The authors are listed in the Appendix. All the authors assume responsibility for the overall content and integrity of the article. Address reprint requests to Ms. Kelsey Mertes at PATH Malaria Vaccine Initiative, Communications and Advocacy Unit, 455 Massachusetts Ave. NW,

Fig. 1 First page of *The New England Journal of Medicine* article showing authorship as a research group rather than as individual authors. From RTS,S Clinical Trials Partnership (2011). Reprinted with permission from Massachusetts Medical Society

material across these studies. At the same time, given the years involved and the large number of authors, we should also expect some changes in authorship between these publications. So we must face a complicated question: under what conditions is it acceptable for one group of authors to recycle material from a prior paper with overlapping but not identical authors?

As in the case of the RTS,S partnership, written documents produced in STEM fields are frequently coauthored in the context of formal research teams—in contrast to ad-hoc groups of colleagues. These teams often have fluctuating membership under the direction of one or more principal investigators. Figure 3 presents a symbolic representation of such research groups: the box represents current members of the team and the arrow represents the flow of researchers in and out of the team.

In academic settings, graduate (and sometimes undergraduate) students and post-docs join a group for some period of time and then move on. A similar flow exists for research teams in government or industry—but perhaps at a slower rate.

To fully understand text recycling in the context of contemporary STEM research, it is useful to consider the research team as a site of textual production. This invites a number of questions: Who is in the group now? Who was in the recent past? Who will join the group in the future? What types of texts does the group generate for a given research project, and how are they related? How are these texts produced, and by whom? Who is listed as an author of these texts and why?

Unlike scholarship in the humanities, determining who should be included as an author of a STEM paper is sufficiently complicated that many journals have adopted

APPENDIX

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Fig. 2 Appendix from *The New England Journal of Medicine* article listing authors. From RTS,S Clinical Trials Partnership (2011). Reprinted with permission from Massachusetts Medical Society

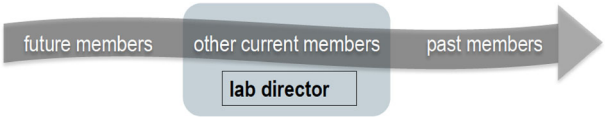


Fig. 3 Schematic of flow of authors in and out of research group

formal policies. The journal *Science*, for example, has the following policy for determining authorship status for research articles (Science 2015):

> Authors in *Science* must fulfill the criteria described below… Specifically, contributions should be one or more of the following:
>
> 1. Formulation of theory and prediction.
> 2. Contributions to experimental conception and design.
> 3. Acquisition, analysis and/or interpretation of data.
> 4. Drafting the article or revising it critically for important intellectual content.
>
> All individuals who meet these criteria *must* [emphasis added] be listed as authors. In addition, all authors must agree to be so listed and are expected to critically read and approve the submitted version and the version to be published.

Note that these criteria specify not only who *can* be included as an author—but also who *must* be.[5] (Note that these criteria are not universal across all journals or fields.)

Given the different roles of team members and the ways in which they move in and out of research teams, the possible relationships between authors and texts are numerous. In order to isolate those concerns related directly to multiple authorship, this discussion is limited to situations in which both the source and destination texts are produced as the work of one group. Table 1 presents five hypothetical cases which schematize the key issues involved. While this schema includes only two or three authors for each text, the concepts generally apply to any number of authors.[6]

Case 1: Identical authors

This is the simplest case, as authors of the source and new work are identical. It would seem that concerns related to plural authorship would not obtain here, so this case would be treated the same as a single-authored paper. We can then think about the other cases in relation to this one.

Case 2: Authors of the new text are a subset of the source text authors

For this case, the essential question is whether A and B can recycle material from the source given that author C, an author of the source text, is *not* an author of the new text. Any answer other than "categorically no," leads to other author-related questions: Is permission from C ever or always *necessary*? Does it matter who originally drafted the recycled material?

Case 3: Authors of the source text are a subset of the new text authors.

In this case, there are authors of the new text who were not authors of the source. Unlike Case 2, getting permission is not an issue. Also, it should not matter which of the source authors originally drafted the recycled material since it would be one of the new text's authors. The only consideration in distinguishing this case from Case 1, it seems, is whether C would be getting some kind of undeserved credit for the work of the others.

Case 4: Overlapping authorship

This case would seem to combine the issues identified for cases 2 and 3, adding complexity but no new concerns.

[5] From a legal/copyright perspective, all authors listed on a publication have equal rights [Deborah Parrish, personal communication]. But the ethics and expectations for text recycling are not the same as copyright law.

[6] While the number of authors used in the cases discussed here—two or three per text—is useful in conceptualizing the various potential concerns, it does have one important limitation: some approaches to addressing multiple-author concerns may be viable for such numbers but unworkable at a larger scale. But should our thinking about these cases be the same for a three-authored paper as for one with one hundred authors? For example, expecting formal permission from Author C in Case 2 is not inherently problematic; but would we also expect such permissions if 20 out of 100 authors of the source paper were not authors of the follow-up paper?

Table 1 Author-text scenarios: all authors working in same group

Case	Author of source text	Author of new text	Notes
1	A B	A B	Reference case: same authors for each
2	A B C	A B	All authors of the new text were authors of the source, but some authors of source are not authors of new text
3	A B	A B C	All authors of the source are authors of new text, but some authors of new text were not authors of the source
4	A B	B C	Some authors of the source are not authors of new text, and some authors of new text were not authors of the source
5	AB	CD	While all of the authors participated as members of the group, the papers share no common authors

Case 5: No author overlap

This case lies at the boundary between text recycling and plagiarism. Imagine that researchers A and B collaborate on a project in a government lab and publish their promising findings from the pilot study. C and D are now hired to join the team, but soon after A and B both depart that agency for other opportunities. C and D continue this research and write the next paper about this research. While this situation would be highly unusual, it is conceptually useful for interrogating the concept of recycling rights belonging to a group rather than to individuals. Authors of the new text may perceive their situation as being at the fringe of Case 4; yet given the absence of shared authors, neither editors nor readers have reason to believe that the authors of the new text have the right to recycle from Paper A—unless, as for the STS, S partnership—authorship is formally attributed to a named research group.

Given the complexities of contemporary multi-authored work as represented in the cases presented above, it is not clear how one might set policies regarding which individual authors have the rights to recycle which material under which conditions. Case 5 puts the matter starkly before us: If authors C and D had no working relationship with A and B or their organization, the reuse of verbatim textual material from A's and B's paper without quotation marks would likely be considered plagiarism. But if C and D are working on the same research in the same group, does this change how we assess the situation? If so, is the situation different in kind from Case 4—where we have at least one overlapping author? How about if the majority of authors overlap, or if all but one of the authors is the same?

The large number of authors on research papers in many STEM fields poses a substantive challenge to framing policies for text recycling. Future changes in policies regarding assigning of authorship may mitigate or exacerbate these challenges. For example, rather than having each person who worked on a research project be listed as an author, Jason Borenstein and Adil Shamoo (2015) have recommended the "contributor model" which states the roles of each contributor to

the project and includes as authors only those who were substantively involved in the actual writing of the manuscript. Limiting authorship in this way would alleviate some concerns regarding who has recycling rights and lessen the burden of obtaining permissions if required. On the other hand, A. M. Petersen, I. Pavlidis, and I. Semendeferi suggest one way STEM authors may address the difficulty of assigning first author and corresponding author for large teams with multiple principal investigators: by producing multiple publications, "whereby several variations of the same paper are submitted to various conferences and journals with permuted author list orderings." (Petersen et al. 2014). Even if this practice does not involve actual duplicate publication, it will likely result in large amounts of text recycling. Unless the list of authors is stable across these talks and publications, the number of issues to be addressed may be magnified.

Boilerplate

As noted above, discussions of text recycling are typically framed in relation to a concept of one's prior work. Yet there are situations in which it may be acceptable for STEM authors to recycle text that was not in any way their "own" to begin with—even if we extend our notion of "one's own work" to include texts produced within the same group. These situations—which we might think of as a kind of *boilerplate*—raise yet more questions about the boundaries between recycling and plagiarism.

Consider "Design Features of Add Health" by Kathleen Harris (2007). In this paper Harris introduces a new research database, the National Longitudinal Study of Adolescent Health, to the social science research community. Here is one passage from this paper presenting some essential factual information about the database [bold font added]:

> The National Longitudinal Study of Adolescent Health (Add Health) **is a longitudinal study of a nationally representative sample of adolescents in grades 7–12 in the United States in 1994–95** who have been followed through adolescence and the transition to adulthood with three in-home interviews…

Now consider Fig. 4, which shows a screen shot from the results of a Google Scholar search for the bolded phrase above.

All of these hits are for studies that used the Add Health database—and all formally cite the Harris paper. But note that while the third entry (Rosenbaum and Rosenbaum) places the reused text in quotation marks, the others do not. The authors of these other papers, it seems, felt it appropriate to recycle rather than quote this material. It is also important to consider here that Harris's paper includes the following statement:

> This document was prepared to be used by those interested in a ready reference for the design features of the National Longitudinal Study of Adolescent Health (Add Health)… Parts of this document may be incorporated into other documents for grant applications, papers for publication, or public presentations, without further permission. This document will be useful for those planning to use existing Add Health data.

Financial hardship and obesity
SL Averett, JK Smith - Economics & Human Biology, 2014 - Elsevier
... 7. 4. Data. As noted above, we use data from the AddHealth, a school-based **longitudinal study of a nationally representative sample of adolescents in grades 7–12 in the United States** which started during the 1994–1995 school year. ...
Cited by 12 Related articles All 12 versions Cite Save

Genetics of educational attainment and the persistence of privilege at the turn of the 21st century
F Nielsen, JM Roos - Social Forces, 2015 - muse.jhu.edu
... 2004). Data and Methods. Data. We use data from the National Longitudinal Study of Adolescent Health (Add Health), a **longitudinal study of a nationally representative sample of adolescents in grades 7–12 in the United States** during the 1994–95 school year. ...
Cited by 10 Related articles All 6 versions Cite Save

Beyond BA blinders: Lessons from occupational colleges and certificate programs for nontraditional students
JE Rosenbaum, J Rosenbaum - The Journal of Economic …, 2013 - ingentaconnect.com
... educational credentials, Janet Rosenbaum (2013) analyzed data from the National Longitudinal Study of Adolescent Health (Add Health).1 This is "a **longitudinal study of a nationally representative sample of adolescents in grades 7–12 in the United States** during the 1994 – 95 ...
Cited by 12 Related articles All 13 versions Cite Save

Clues of subjective social status among young adults
F Nielsen, JM Roos, RM Combs - Social science research, 2015 - Elsevier
... 3. Data. 3.1. The Add Health study. We use data from the National Longitudinal Study of Adolescent Health (Add Health), a **longitudinal study of a nationally representative sample of adolescents in grades 7–12 in the United States** during the 1994–95 school year. ...
Cited by 7 Related articles All 7 versions Cite Save

Differences in substance use and substance use risk factors by Asian subgroups.
RA Shih, JS Tucker, JNV Miles, BA Ewing… - … American journal of …, 2015 - psycnet.apa.org
... with Japanese, Filipino, Chinese, Korean, and Vietnamese ethnicities in one wave of the National Longitudinal Study of Adolescent Health (Add Health), a **longitudinal study of a nationally representative sample of adolescents in Grades 7–12 in the United States** (Choi, 2008 ...
Cited by 2 Related articles All 8 versions Cite Save

Fig. 4 Five of the 76 hits from Google Scholar for the phrase "longitudinal study of a nationally representative sample of adolescents in grades 7–12 in the United States." The phrase is originally from "Design Features of Add Health" (Harris 2007)

The very presence of such a statement suggests that recycling material from this type of source may not be uncommon in those disciplines that would use such a database.

This case suggests that there are indeed situations in which some authors in some fields may consider it acceptable to recycle text from sources for which neither they nor their colleagues were authors. We might then ask questions about such situations:

- Are there necessary characteristics of source material that might be recycled? For example, is it necessary that the recycled text be informational rather than intellectual in nature?
- Is the presence of a permission statement such as that shown above either necessary or sufficient?
- Are there categories of text and/or sources which make the practice acceptable within disciplines-specific contexts? For example, thinking about

the Add Health case, is it generally acceptable within sociology to recycle descriptions of sampling methods regarding research databases?

Genre

To date, guidelines and discussions of text recycling have been limited mostly to consideration of published materials, and primarily to journal articles. Nevertheless, the contemporary scientific research enterprise involves many other genres: conference abstracts, grant proposals, IRB protocols, and so on—any of which might be sources or destinations of recycled material. Authors and editors need guidance for these genres as well.

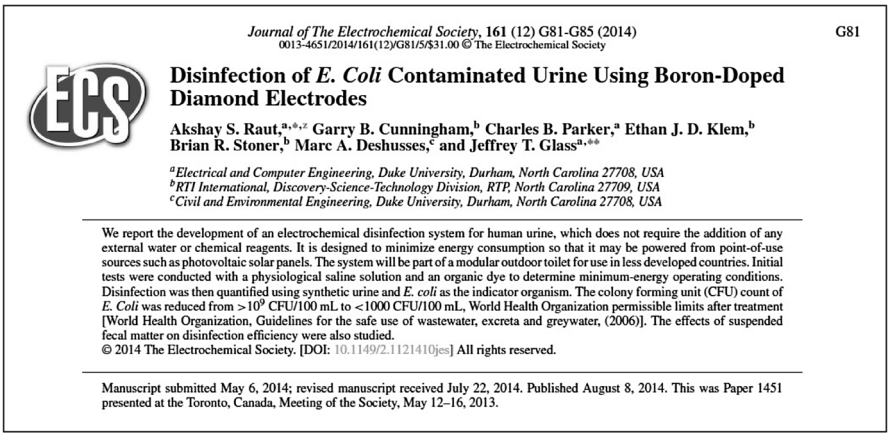
For our purpose here, we might characterize genres according to whether they are published documents or work in progress. For example, in many STEM fields, it is common practice to present preliminary findings in a conference talk or poster—with the understanding that this interim-stage work will be revised and expanded on its way to becoming a journal article. In these fields, the community might *expect* that significant chunks of material from the unpublished documents will be recycled in the preparation of the article manuscript. In some cases, developing guidelines for such situations might be fairly straightforward. Yet the binary of work-in-progress vs. publication is not without its limitations.

A particularly challenging situation is the recycling of material when extending a conference proceedings paper to a journal article—which Robinson refers to as the "cannibalised conference paper" (2014). This practice is common in some STEM fields, and studies by Zhang and Jia show that a large proportion of authors (Zhang and Jia 2012) and editors (Zhang and Jia 2013) believe the practice to be acceptable as long as the journal article contains a substantial amount of new material. Nevertheless, few guidelines on text recycling addresses the practice. One of the few that do is Ithenticate's white paper, "The Ethics of Self-Plagiarism." (Ithenticate 2011):

> Let's look at one scenario: Leslie is an assistant professor going through tenure review with significant pressure to publish. An article she is writing for a journal piggybacks on a recent conference presentation that was also published by the conference sponsor. Leslie would like to integrate the writing from the conference presentation into the article. She faces an ethical dilemma: to repurpose her own writing from one text and use it for another, thereby increasing her number of publications for tenure, but from the same work. Doing so, Leslie might commit what Scanlon (2007) calls "academic fraud," a form of self-plagiarism.

Readers of this document are led to believe that recycling from proceedings to publication is inherently unethical—a position that is taken without justification and contradicts the empirical findings of Zhang and Jia.

To understand the complications involved with recycling material from a conference paper, let us consider a real-world case: a research project on the development of an electrochemical disinfection system for human urine designed for



Journal of The Electrochemical Society, **161** (12) G81-G85 (2014)
0013-4651/2014/161(12)/G81/5/$31.00 © The Electrochemical Society

Disinfection of *E. Coli* Contaminated Urine Using Boron-Doped Diamond Electrodes

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We report the development of an electrochemical disinfection system for human urine, which does not require the addition of any external water or chemical reagents. It is designed to minimize energy consumption so that it may be powered from point-of-use sources such as photovoltaic solar panels. The system will be part of a modular outdoor toilet for use in less developed countries. Initial tests were conducted with a physiological saline solution and an organic dye to determine minimum-energy operating conditions. Disinfection was then quantified using synthetic urine and *E. coli* as the indicator organism. The colony forming unit (CFU) count of *E. Coli* was reduced from $>10^9$ CFU/100 mL to <1000 CFU/100 mL, World Health Organization permissible limits after treatment [World Health Organization, Guidelines for the safe use of wastewater, excreta and greywater, (2006)]. The effects of suspended fecal matter on disinfection efficiency were also studied.
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ECS Transactions, 53 (17) 1-11 (2013)
10.1149/05317.0001ecst ©The Electrochemical Society

Electrochemical disinfection of human urine for water-free and additive-free toilets using boron-doped diamond electrodes

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c Civil and Environmental Engineering, Duke University, Durham, NC 27708, USA

We report the development of an electrochemical disinfection system for human urine, which does not require the addition of any external water or chemical reagents. It is designed to minimize energy consumption so that it may derive its energy from solar panels. The system will be part of a modular outdoor toilet for use in developing countries. The system was tested with a physiological saline solution and an organic dye to determine minimum-energy operating conditions. Disinfection was then quantified using synthetic urine and *Escherichia coli* (*E. Coli*) as indicator organisms. The colony forming unit (CFU) count of *E. Coli* was reduced from $>10^9$ CFU/100 mL to within World Health Organization permissible limits after treatment. Effects of suspended fecal matter on disinfection efficiency were also studied.

Fig. 5 Images of top of first page for journal article and conference proceedings. Reproduced by permission of The Electrochemical Society

developing nations. Figure 5 presents parts of the first page of two papers produced in this research effort: a conference proceedings paper and a journal article (Fig. 5).

Note that both papers are from the same publisher, the Electrochemical Society (ECS). The proceedings paper, presented at an ECS Meeting in 2013, is from *ECS Transactions* (Raut et al. 2013). The other paper (Raut et al. 2014) is from the *Journal*

of The Electrochemical Society (JES), the flagship journal of the ECS. According to the ECS website, *JES* is "one of the leading journals in the field of electrochemical science and technology, and is currently the first most-cited journal in Materials Science, Coatings and Films and second most-cited journal in Electrochemistry."

Like virtually all academic journals, JES has a policy against accepting manuscripts that have been previously published:

> The Journal of The Electrochemical Society (J. Electrochem. Soc.) is the official journal of ECS. All manuscripts submitted are considered for publication, with the understanding that they have not been published or submitted for publication elsewhere.

In light of this policy, consider Fig. 6. On the left is an excerpt from the *Transactions* paper; on the right is the corresponding text from the journal article.

While the two papers are not identical, there is clearly extensive overlap of not only text but also content: the journal text (right) fleshes out the text from the conference proceedings (left). So does the ECS consider its proceedings papers to be published or not? There is at least some reason to think that it does. For one thing, the link to *ECS Transactions* on the ECS website is on the "Publications" tab, under "Meeting Publications." For another, it is described on the ECS site as "a high-quality venue for authors and an excellent resource for researchers." And *ECS Transactions* are also "published" in that they are disseminated through formal channels and are given formal citations and DOI numbers. (This one is *ECS*

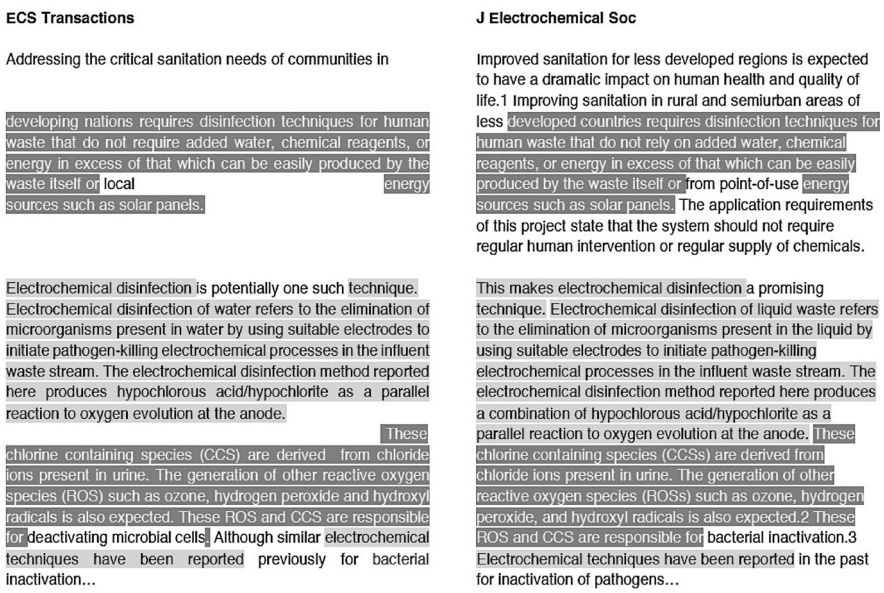


Fig. 6 Example of recycling between conference proceedings (Raut et al. 2013, p. 1) (left) and journal article (Raut et al. 2014, p. G81) (right). The source text is presented with extra space between some lines in order to better show correspondence of material

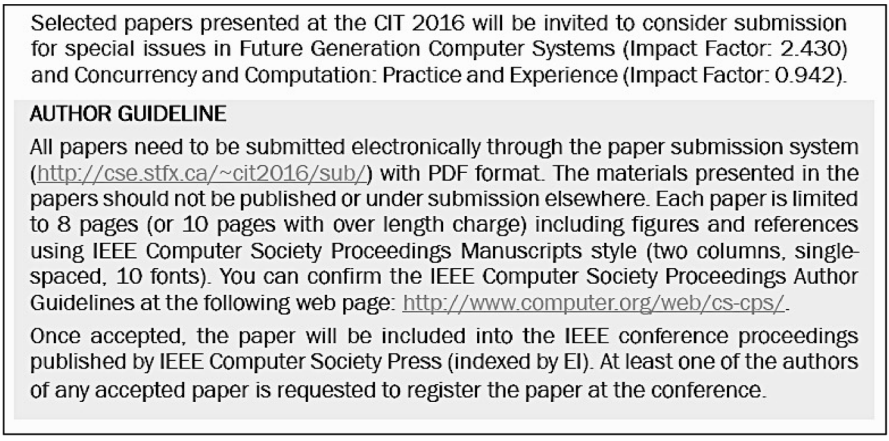
Trans. 2013, volume 53, issue 17, 1–11; doi: https://doi.org/10.1149/05317.0001ecst.). Finally, author guidelines for the *JES* include specific instructions for citing papers from *ECS Transaction.*

Yet, in another way, the ECS does not seem to consider *Transactions* papers to be publications. In spite of its prohibition against submitting published manuscripts, the ECS encourages authors of *Transactions* papers to submit revised versions to the *JES* as journal articles. According to the *JES* guidelines for authors:

> Papers presented at ECS meetings and manuscripts published in ECS Transactions may be submitted to the Journal. Although there is no hard deadline for the submission of these papers, it is considered that six months from the date of the symposium is sufficient time to revise a paper to meet the stricter standards of the Journal. (Journal of The Electrochemical Society 2011)

Like many professional societies, the ECS seems to consider conference proceedings to be a kind of pseudo publication. Expectations of the ECS regarding text recycling—and even duplicate publication—between these genres are certainly unclear.

Making matters even more confusing, some STEM fields, such as computer science, consider proceedings to be the final level of publication—the equivalent of a journal article. And some academic journals use the word *proceedings* in their titles. *Mayo Clinic Proceedings* describes itself as "One of the premier peer-reviewed clinical journals in general and internal medicine" (Mayo Clinic 2017). The Institute of Electrical and Electronics Engineers (IEEE), one of the largest of STEM professional societies, is perhaps even more confusing. According to its website, the journal *Proceedings of the IEEE* is "an archival, refereed monthly journal that covers all aspects of electronics, electrical and computer engineering, and computer science" (IEEE 2017). However, IEEE also runs dozens of


Selected papers presented at the CIT 2016 will be invited to consider submission for special issues in Future Generation Computer Systems (Impact Factor: 2.430) and Concurrency and Computation: Practice and Experience (Impact Factor: 0.942).

AUTHOR GUIDELINE

All papers need to be submitted electronically through the paper submission system (http://cse.stfx.ca/~cit2016/sub/) with PDF format. The materials presented in the papers should not be published or under submission elsewhere. Each paper is limited to 8 pages (or 10 pages with over length charge) including figures and references using IEEE Computer Society Proceedings Manuscripts style (two columns, single-spaced, 10 fonts). You can confirm the IEEE Computer Society Proceedings Author Guidelines at the following web page: http://www.computer.org/web/cs-cps/.

Once accepted, the paper will be included into the IEEE conference proceedings published by IEEE Computer Society Press (indexed by EI). At least one of the authors of any accepted paper is requested to register the paper at the conference.

Fig. 7 From the Call for Proposals for the 16th IEEE International Conference on Computer and Information Technology

conferences every year, each with its own conference proceedings. For example, as shown in Fig. 7, *all papers* accepted for the IEEE International Conference on Computer and Information Technology are "published" in the proceedings. Some of these will also be "invited to consider submission" to an IEEE journal.

Given this variability in how different fields (and even specific publishers) view conference proceedings, authors and editors will likely be confused about expectations regarding text recycling from proceedings to article.

As the above examples show, norms for text recycling are genre-dependent. In order to investigate these norms, it would be useful to categorize research-related genres. Table 2, suggests one such categorization and provides common examples of each. The categories are as follows:

- *Workplace* texts are related to the research effort, but are not part of the scholarly work itself and are not disseminated.
- *Public* texts are used to disseminate scholarly ideas but do not rise to the level of "publication."
- *Published* texts are accepted as the formal presentation of that particular intellectual work to the target community.

This categorization helps us imagine some *possible* views one might hold and think about how these views might be articulated. Miguel Roig, for example, states that "any reuse of limited-circulation internal-type documents (e.g., IRB protocols) should, when applicable, have the approval of the institution under which they were generated and also of any coauthors of the original documents" (Roig 2006). Regardless of whether scholarly communities would agree with Roig on the need to get institutional permission to recycle text from one's own IRB protocols, we can view this statement as a position on workplace documents. Given this categorization scheme, one might articulate a number of genre-specific positions. For example:

- "Authors may freely recycle material to or from any genre that is not considered a 'publication.'"
- "When writing published genres, recycled material should be limited in quantity and by the rhetorical nature of the material."
- "Authors may freely recycle to or from workplace genres that are not publicly circulated or other texts not publicly circulated."

And so on. Regardless of one's positions on these matters, thinking about genres categorically may bring some useful clarity to this discourse.

Table 2 Categories of genres as related to text recycling

Workplace	Public	Published
Grant proposal	Conference poster	Journal article
Grant report	Conference talk	Review article
IRB protocol	Conference proceedings[a]	Conference proceedings[a]
Conference proposal	Blog posts	Opinion piece (e.g., commentary, letter to the editor)

We can also think about genres through a different lens—one focused on the rhetorical sensibilities of the genres. Figure 8 illustrates this idea as a spectrum—with literary genres to the left and informational, report-like genres to the right.

This spectrum is intended to align with authors' sensibilities about the "specialness" of their prose. Novelists, poets, and authors of literary essays, for example, are likely to consider the choice and arrangement of words to be a fundamentally important aspect of their work. Writers of corporate annual reports (we would not likely think of them as "authors") are unlikely to have the same sense of ownership of the language used in their reports; in fact, we would expect much of the prose to be boilerplate—reused from prior-year's reports whenever possible. The scientific research report lies somewhere in between: it is not a work of literary art, but its function is intellectual rather than purely informational. Narrowing our focus to STEM research, we could also organize key research-related genres along this spectrum, as shown in Fig. 9.

Thinking of genres this way—as lying along a spectrum from essayistic (essay-like) to what we might call *reportistic* (report-like)—provides another heuristic for thinking about genre in relation to ethics and expectations for text recycling.

Regardless of how we frame it, guidelines for text recycling clearly need to address the matter of genre—for both the source and the destination of recycled material. And as the example of the conference proceedings shows, any consideration of genre needs to take disciplinary differences into consideration.

School

Whether in the role of student, teacher, or collaborator, those involved with scientific research in academic settings routinely face text-recycling situations specific to that setting. To get a sense of these particular challenges, consider again the Electrochemical Society case discussed above. When both the *JES* and *Transactions* papers were written, three authors were faculty, three worked at a nonprofit institute, and one was a graduate student. Figure 10 shows passages from the *JES* article on the left and from the student's dissertation, submitted after the *JES* article was published, on the right. The two passages are identical except for the first word.

The practice of recycling material from published articles into one's dissertation is common in some STEM fields. In fact, in some STEM departments, Ph.D. students are encouraged to publish their research findings as early as possible to

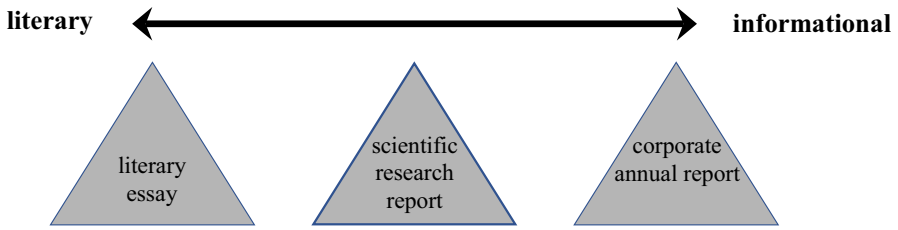


Fig. 8 Genres on a spectrum from literary to informational

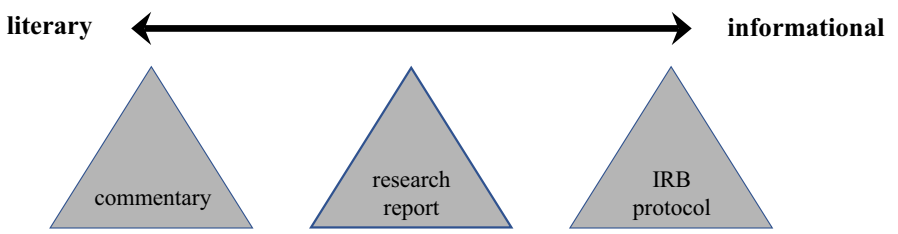


Fig. 9 STEM research genres on a spectrum from literary to informational

JES article

Specifically, we report on the disinfection of synthetic human urine and feces using an electrochemical cell comprised of a boron-doped diamond anode and tungsten cathode at different applied voltages and hence different current densities. Total chlorine was measured and used as an indicator of electrochemically generated oxidants. The effect of suspended synthetic feces (1% and 2% w/v) in synthetic urine on the disinfection process was also studied. Finally, the energy and time required for disinfection for different voltages were calculated. To our knowledge, no previous literature reports have focused on developing a liquid disinfection system that can treat undiluted human urine at point of source, operate without flush water or added reagents, and will be able to handle small amounts of suspended fecal particles with the associated bacteria.

Dissertation

Herein, we report on the disinfection of synthetic human urine and feces using an electrochemical cell comprised of a boron-doped diamond anode and tungsten cathode at different applied voltages and hence different current densities. Total chlorine was measured and used as an indicator of electrochemically generated oxidants. The effect of suspended synthetic feces (1% and 2% w/v) in synthetic urine on the disinfection process was also studied. Finally the energy and time required for disinfection for different voltages was calculated. To our knowledge, no previous literature reports have focused on developing a liquid disinfection system that can treat undiluted human urine at point of source, operate without flush water or added reagents and will be able to handle small amounts of suspended fecal particles with the associated bacteria.

Fig. 10 Example of recycling text between journal article on left (Raut et al. 2014; *Journal of The Electrochemical Society* and dissertation by student member of the research group on right

prepare for the job market—with the expectation that much of the material from these published papers will be recycled rather than rewritten in their dissertations. Interestingly, three of the authors of the ECS papers were also authors of "Achieving Excellence in Graduate Research: A Guide for New Graduate Students," which contains the following passage in the section entitled "Publish or Perish":

> Write papers as you go along, not at the end of your degree. … Remember, it is in your best interest to get as many high-quality publications as possible from your work, especially if you want to go into academics. …Publications are also generally a good way to determine if you have completed sufficient research for your dissertation. The question "when can I graduate" is much easier to answer when you think about how many papers you and your advisor expect you to submit before you defend your dissertation. (Parker et al. 2015, p. 2)

So we see that in some academic contexts, students are encouraged if not even expected to publish prior to writing their dissertation. These expectations raise questions about norms and ethics for recycling in manuscripts submitted for degree certification. Should graduate programs condemn or condone recycling from published article to dissertation?[7] Should this be a school-wide policy, or should individual departments (or even individual faculty) be left to decide on their own? Is it acceptable to hold students at the same institution to different standards based on disciplinary norms or the beliefs of their mentors?

There is also the matter of multiple authorship: in many STEM fields, nearly every paper published by a graduate student will have coauthors—including but not limited to the student's mentor and other professional researchers (as in the ECS case). Often other graduate students or postdocs will share authorship as well. This results in a situation which we might see as the extreme version of Case 2 discussed in the Authorship section above. In the ECS case, material from a publication with seven authors is recycled in a single-authored dissertation manuscript. Given that some of the student's coauthors would also be members of his doctoral committee, it seems unlikely that there was any deception involved. Are the expectations or ethics in this academic context substantively different than in the professional setting? And if so, how and where should these matters be articulated?

Clearly, student researchers and those who work with them would benefit from guidelines that address text recycling issues not covered by those intended for professionals. In forming such guidelines, we might think of genres specific to the educational setting as being of two types: documents that fulfill degree requirements outside of particular courses—namely dissertations, master's theses, and, at some institutions, undergraduate theses—and those that are assigned within specific courses, such as research papers and lab reports. Such guidelines might address questions such as these:

- In what circumstances should the norms for student-authored texts be different from the professional norms for the student's discipline?
- Does work submitted for course credit ever constitute prior dissemination or otherwise limit students' rights to recycle coursework for non-curricular distribution?
- When can students recycle from multi-authored documents into solo-authored academic documents (such as the dissertation example above)?
- For any of the above, what kinds of disclosure or permissions are needed?

Attribution and Identification

On its webpage "Self-Plagiarism," the U.S. Office of Research Integrity (ORI) frames the ethics of text recycling as a matter of disclosure: "[S]elf-plagiarism refers to authors who reuse their own previously disseminated content and pass it off as a "new" product *without letting the reader know that this material* has appeared

[7] While not as common as for graduate students, undergraduate students and programs may face the same concerns. See, for example, Moskovitz (2015).

previously" [emphasis added] (Roig 2015). But what the ORI expects of authors is not clear: Quotation marks? A citation? A footnote? One of the key points of contention regarding the ethical use of text recycling—and even what constitutes text recycling— is whether and how recycled material should be identified. This is typically addressed only as a matter of citation, but there are actually three distinct practices to consider:

- attributing the *source* of recycled material (citation),
- stating whether the document contains *any* recycled text (disclosure), and
- noting which *specific text* has been recycled (identification).

For some organizations, citing the source of recycled material appears to be both necessary and sufficient to shift the act of reuse from unethical "self-plagiarism" to ethically acceptable text recycling. Some organizations define self-plagiarism explicitly as a matter of citation: For example, the U.S. Environmental Protection Agency states, "Self-plagiarism is the reuse of significant portions of one's own work without citing the original work" (2016). Similarly, in its "Policy and Procedures on Plagiarism," the Association for Computing Machinery (2010) states that "we define self-plagiarism as the verbatim or near-verbatim reuse of significant portions of one's own copyrighted work without citing the original source." It is interesting that these organizations (and others) use a definition of self-plagiarism (stating what self-plagiarism *is*) as a stand in for a direct statement about appropriate practice. It is also worth noting that these statements allude to a threshold, however ambiguous, regarding the quantity of recycled material (see "Quantity" above). One might reasonably infer that recycling anything less than a "significant portion" of material is acceptable without a citation.

In contrast to the above examples, the Publication Manual of the American Psychological Association (2010) explicitly states that where the quantity of material is limited it is acceptable for authors to recycle text without citation:

> There are, however, limited circumstances (e.g., describing the details of an instrument or an analytic approach) under which authors may wish to duplicate without attribution (citation) their previously used words, feeling that extensive self-referencing is undesirable or awkward. When the duplicated words are limited in scope, this approach is permissible. When duplication of one's own words is more extensive, citation of the duplicated words should be the norm.

Setting expectations for citation as a function of quantity leaves much room for uncertainty—especially so given the lack of consensus across disciplines.

Citation alone, however, does not indicate that any text has been recycled. In writing the paper for a follow-up study to a previously published work, authors will likely cite their prior paper whether or not they choose to recycle any material from it. So while citation is clearly relevant for concerns about possible duplicate publication or "salami-slicing," its role in relation to text recycling is more ambiguous than one might expect. To understand this ambiguity, consider three scenarios involving a hypothetical Paper A and a follow-up publication by the same authors, Paper B:

> *Scenario 1*: Paper B cites Paper A as part of the relevant literature, but no text is recycled. This is the typical situation in which authors cite their prior work—for its content alone.
>
> *Scenario 2*: Same as 1, but Paper B contains some recycled text from Paper A.
>
> *Scenario 3*: Paper B contains some recycled text from Paper A (perhaps regarding some bit of methodology), but Paper A is *not* relevant as literature for the new paper and thus *not* cited for its content.

Comparing scenarios 1 and 2, we see that the citation itself communicates nothing to readers regarding recycling; scenarios 1 and 2 appear identical to readers since Paper A is cited *regardless* of recycling.

So, if authors are expected to explicitly announce the presence of text recycling, something more or other than a citation is required. Is it necessary or sufficient for authors to merely note that some *unspecified* text from the source has been included, to the effect of, "Some material in this paper [or perhaps section] has been recycled from Paper A"? If so, the wording of such a statement is important. We can see potential confusion about such wording in the BioMed Central guidelines, in the discussion of how editors should decide whether recycled text is acceptable in a Methods section: "An important factor to consider is whether the authors have been transparent, stating that the methods have already been described elsewhere and providing a citation." (BioMed Central 2013) *Transparent* here is clearly in reference to text recycling; but neither a statement that methods have been "described elsewhere" nor a citation explicitly announces the presence of recycled text. A paper could include both a citation and such a statement and still include only paraphrased rather than recycled text.

For a real-world example of such ambiguity, consider the following case from two of the most prestigious journals in all of science. The first passage below is from a 2010 paper published in *Science* by Gneezy et al:

> We conducted a field study at a large amusement park (8). Participants (N = 113,047) rode a roller coaster–like attraction, were photographed during the ride, and later chose whether to purchase a print of the photo.

This next passage is from a subsequent paper by Gneezy et al, published in *Proceedings of the National Academy of Sciences (PNAS)* in 2012:

> The data in this section is largely based on a new analysis of Gneezy et al. (7). We conducted a field study at a large amusement park. Participants rode a rollercoaster-like attraction, were photographed during the ride, and later chose whether to purchase a print of the photo.

Note the first sentence in the *PNAS* excerpt. It alerts readers that this part of the paper contains an analysis of previously published data and it contains a citation to the earlier paper. But it says nothing about the presence of recycled text.

One of the few guidelines that offers authors explicit language for announcing the presence of recycled text is the American Meteorological Society's "Policy on Plagiarism and Self-Plagiarism." It contains the following passage:

> To avoid self-plagiarism, sections containing duplicate or similar text must (i) appropriately cite the original source to promote the primacy of the source and (ii) indicate that the text largely follows directly from that source [e.g., "The description of the dataset parallels that of Smith et al. (1980) as follows in the next two paragraphs." or "The methods are the same as employed in Smith et al. (2008), and the following text is derived from there with minor modifications."]. (Schultz et al. 2015)

If organizations expect authors to announce the presence of recycled text, they might consider this model.

Expecting authors to identify *which* specific text is recycled poses additional syntactic and rhetorical difficulties. The standard mechanisms for identifying specific words for readers is via quotation (quotation marks or block indentation) or italics. However, it is the nature of both mechanisms to draw readers' attention to the words, which for recycled text would be misleading and distracting. In addition, while the scientific community might be willing to accept a set of quotation marks or two to identify recycled text, the number of quotation marks needed for common situations involving multiple, discrete chunks of recycled material is unlikely to be acceptable (see "Distribution of Material"). One viable alternative emerges if we consider that there are two distinct audiences for a scientific manuscript: those involved in the editorial process and the ultimate consumers of the text. One might ask authors to identify recycled material for the editors but not for general readers, by, say, highlighting recycled material in the manuscript. Such identification allows authors to be fully transparent and publishers to make informed decisions about the acceptability of recycled material, without interfering with the ultimate readability of the published text.

This takes us to Scenario 3, which poses additional challenges. One of these is concern with excessive self-citation, as noted in the American Psychological Association guidelines quoted above. Is it acceptable to have citations to one's prior work merely for the sake of transparency regarding text recycling? There is also the matter of just how and where such a citation would be placed if a paper is relevant *only* as a source of recycled material. Conventions for citing sources *merely* to acknowledge recycling do not yet exist. (A similar challenge exists for identifying recycled visuals such as diagrams or tables. See "Recycling Visual Materials" below).

A casual survey suggests that most organizations do not address the matter of whether recycled text need be explicitly identified. A rare example of an explicit statement on this matter is the Association for Computing Machinery's "Policy and Procedures on Plagiarism," which—while requiring citation of the source—does not require identification of the recycled material:

> Note that self-plagiarism does not apply to publications based on the author's own previously copyrighted work (e.g., appearing in a conference proceedings) where an explicit reference is made to the prior publication[3]. Such

> reuse does not require quotation marks to delineate the reused text but does require that the source be cited. (Association for Computing Machinery 2010)

Should authors infer that organizations which are silent on this detail consider such identification to be unnecessary?

The above discussion shows that there are important gaps and inconsistencies in organizational policies related to attribution and identification of recycled text—in both the substance of the policies and in which factors they happen to include in their statements. Organizations might therefore consider including specific statements about requirements (or lack thereof) for each of the three items listed at the start of this section: a citation, a statement of whether *any* text has been recycled, and/or identification of any recycled text. This means, of course, that organizations must make decisions about each of these items.

Recycling Visual Materials

Graphs, tables, diagrams, and other visual materials are an essential component of writing across STEM fields. STEM authors and editors thus need to understand the ethics and expectations associated with recycling visual materials. Nevertheless, nearly all official guidelines and publications addressing text recycling are limited to consideration of prose.

The few documents that do address the recycling of visual materials do so in such an offhanded way, they may only serve to confuse or mislead readers. One of these documents is Biomed Central/COPE's widely circulated document "How to deal with text recycling" (BioMed Central 2013). The only mention of visuals here is a single sentence: "Reproduction of previously published figures or tables may represent data duplication if the authors do not provide a justification (see 'Results') and, if reproduced without permission, may result in copyright infringement." A second case is Bruton's essay "Self-Plagiarism and Textual Recycling: Legitimate Forms of Research Misconduct." The only explicit comment on visuals here is a brief and unsupported assertion in the introduction suggesting that recycling visuals is categorically unethical: "Most also recognize that it is wrong to reuse photographs and other graphics from one's previous publications" (Bruton 2014, p. 177). (Bruton makes one other mention of visuals in one of his two case studies, but he does not address the matter directly.) These documents are discussed here not as criticism but to show that even those who have devoted time and attention to the issue of text recycling tend to overlook or underappreciate the importance of visual materials.

Establishing guidelines for recycling visual materials will be no simpler than for prose, since many of the same factors are relevant in determining acceptability: rhetorical function, authorship, and so on. While the BioMed/COPE guidelines discuss visuals only in the context of presenting results, scientists use visuals to accomplish many other aims and recycling in these situations may more acceptable. Consider, for one example, the common situation shown in Fig. 11. This shows a pair of figures from two papers by the same authors reporting on applied

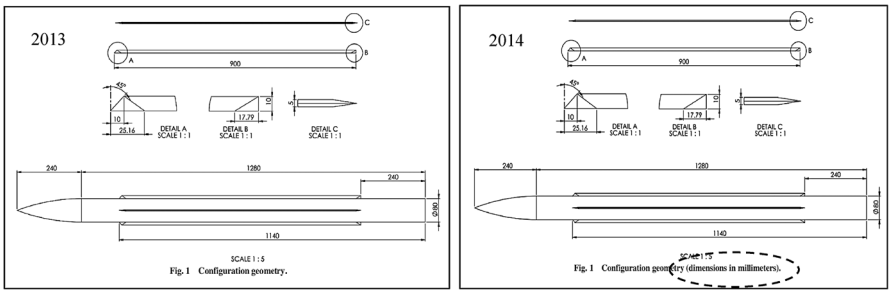


Fig. 11 Example of recycled figure between journal articles. Both are published in the *Journal of Spacecraft and Rockets* by the same authors. Left: Two-Dimensional Potential Method Simulations (Tuling et al. 2013). Right: Two-Dimensional Potential Method Simulations of a Body–Strake Configuration (Tuling et al. 2014). Captions are also identical except for note regarding dimensions—identified here with dashed oval

aerodynamics research: Lee-Side Flow Structures of Very Low Aspect Ratio Cruciform Wing–Body Configurations (Tuling et al. 2013) and "Two-Dimensional Potential Method Simulations of a Body–Strake Configuration" (Tuling et al. 2014). Both appear in the *Journal of Spacecraft and Rockets* published by the American Institute for Aeronautics and Astronautics.

The function of these diagrams is to define variables and orient the reader to the geometric conventions followed. While the two manuscripts present substantively different science, both studies use the same physical geometry and thus share these conventions. Researchers following this line of work may well consider the recycling of visual materials for such purposes to be not only acceptable but perhaps even preferable to producing notably different but equivalent drawings.

To get a broader sense of the issues involved with the recycling of visuals, consider again the pair of papers published by the Electrochemical Society discussed above. Figures 12, 13 and 14, contain, respectively, a pair of photographs,

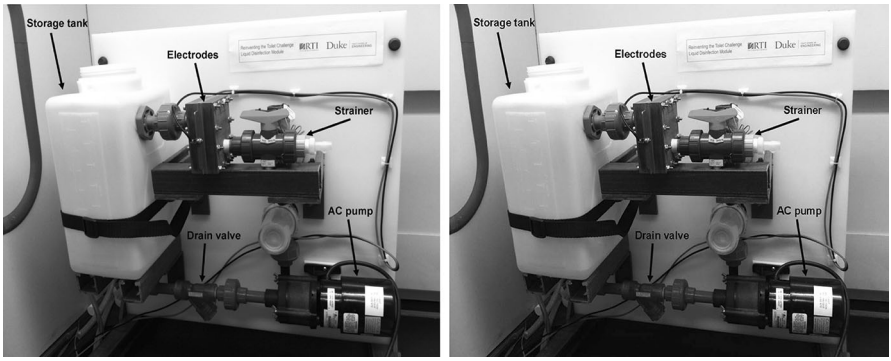


Fig. 12 Example of exact duplication of visual. Photographs of test system in two publications: conference proceedings (*ECS Transactions*) on left; journal article (*Journal of The Electrochemical Society*) on right. Reproduced by permission of The Electrochemical Society

Table 1: Recipe for synthetic urine

Chemical	Quantity (per L of deionized water)
Sodium sulfate	2.34 g
Potassium chloride	3.88 g
Ammonium hydroxide (28-30%)	1.33 mL
Magnesium sulfate (heptahydrate)	0.49 g
Disodium hydrogen phosphate	1.85 g
Phosphoric acid (85% aqueous Solution)	0.25 mL
Sodium hydroxide	0.14 g
Sodium chloride	9.93 g
Trisodium citrate (dihydrate)	0.47 g
Urea	30.3 g
Creatinine	1.47 g
Hippuric acid	0.54 g
Uric acid	0.5 g

Table I. Composition of the synthetic urine.

Chemical	Quantity (per liter of deionized water)
Na_2SO_4	2.34 g
KCl	3.88 g
NH_4OH (28–30%)	1.33 mL
$MgSO_4 \cdot 7H_2O$	0.49 g
Na_2HPO_4	1.85 g
H_3PO_4 (85% aqueous solution)	0.25 mL
NaOH	0.14 g
NaCl	9.93 g
Trisodium citrate $\cdot 2H_2O$	0.47 g
Urea	30.3 g
Creatinine	1.47 g
Hippuric acid	0.54 g
Uric acid	0.50 g

Fig. 13 Example of recycling of a table. Composition of synthetic urine in two publications: conference proceedings (*ECS Transactions*) on left; journal article (*Journal of The Electrochemical Society*) on right. Reproduced by permission of The Electrochemical Society

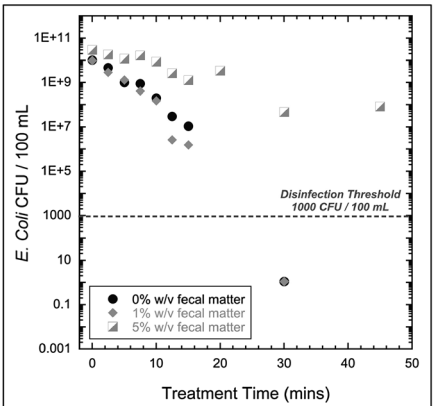


Figure 5: Plot of *E. Coli* in CFU / 100 mL versus treatment time for 0%, 1% and 5% v/w synthetic fecal matter and synthetic urine with *E. Coli* at 6 V electrode voltage

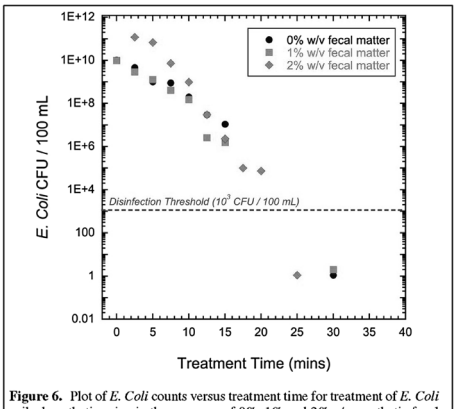


Figure 6. Plot of *E. Coli* counts versus treatment time for treatment of *E. Coli* spiked synthetic urine in the presence of 0%, 1% and 2% v/w synthetic fecal matter at 6 V electrode voltage.

Fig. 14 Example of recycling figure with new data. Conference proceedings (*ECS Transactions*) on left; journal article (*Journal of The Electrochemical Society*) on right. Note difference in data presented: 5% vs. 2% fecal matter. Reproduced by permission of The Electrochemical Society

a pair of tables, and a pair of graphs; to the left are materials from *ECS Transactions*, to the right, the *Journal of The Electrochemical Society*.

From a rhetorical perspective, the contents of Figs. 12 and 13 are rather different from Fig. 14. Figures 12 and 13 seem to be primarily informational in nature: the photograph in Fig. 12 shows readers what the prototype looks like and identifies basic components, while the tables in Fig. 13 give the recipe for the synthetic urine used to test the device. The photographs in Fig. 12 are clearly identical. Given that both papers present findings using this single device, it is difficult to imagine that anyone would object to the reuse of the photograph. And what is the alternative? To take a different photograph of the prototype? In Fig. 13, the *content* of the two tables is identical, yet they are distinctly different: the journal version (on the right) has been rewritten using chemical notation: KCL for potassium chloride, NaOH for sodium hydroxide, and so on. Given that the audience for the proceedings paper and journal article would be essentially the same, what is the rationale for such revision?

From the reader's perspective, is the revised version, with its substituted "synonyms," more or less desirable than recycling the table without changes?

In contrast to the Figs. 12 and 13, Fig. 14 presents results. Like the tables in Fig. 13, the two versions are similar in content, but not identical. But unlike Fig. 13, the differences here are substantive. In the *Transactions* paper, the authors use this figure to argue that the treatment works as well with a 1% addition of fecal matter as for no fecal matter (0%), but that it fails to completely purify in the presence of 5% fecal matter. The data in the journal article builds on this earlier finding. Additional data are presented in the figure, showing that the treatment works even with 2% fecal matter. Clearly much of this figure has been recycled—but it has been revised in ways that are important and appropriate for the new context.

The different purposes served by the examples discussed above are likely to be important in judging the appropriateness of recycling visual materials. In conducting a series of related investigations, STEM researchers often collect data that are intellectually distinct yet similar in nature (same variables or metrics) for which they need to do the same type of analysis or make analogous comparisons. Having laid out the graphics for presenting such data in an earlier paper, authors will often reuse that formatting in presenting data in a new paper. This situation—in which authors want to show new data in relation to previously collected (or computationally or theoretically generated) data—is common in STEM research. Thus, it is important to clarify the ethics and expectations regarding this type of template recycling for visuals. Should authors be free to recycle the apparatus of such figures—axis labels, keys and so on—or not? And what about captions? Each of the pairs of captions in this set of visuals seems to include arbitrary differences. Are such changes necessary or desirable?

In addition to serving as examples of the kinds of visuals that STEM researchers might recycle, these exhibits also raise interesting comparisons with prose recycling. Are the ethics of recycling the "informational" image in Fig. 12 fundamentally different from those of recycling informational prose—say a prose description of this apparatus? Similarly, consider Fig. 15—which presents the prose that accompanied the figures shown in Fig. 14. Are the ethics of recycling an

ECS Transactions

Synthetic urine mixed with synthetic fecal matter and E. Coli was also tested. Two tests were conducted with 1% and 5% w/v fecal matter. The reduction of viable E. Coli was compared to that with no fecal matter. The result is illustrated in Figure 5. All experiments were conducted at an electrode voltage of 6 V. The disinfection time for synthetic urine with 1% w/v synthetic fecal matter was similar to the disinfection time for synthetic urine with no fecal contamination. ... After the completion of the synthetic fecal contamination experiments the BDD anode and tungsten cathode were carefully examined to determine if any scaling or fouling was present. Both electrodes surfaces were found to be free of fouling.

Journal Electrochemical Society

Synthetic urine mixed with simulant fecal matter and E. Coli was also tested to determine the effect of added organic matter and suspended solids on the process. The results are reported in Figure 6. The disinfection time in the presence of fecal matter simulant was similar to the disinfection time without fecal contamination (25–30 minutes). After the completion of these experiments, the BDD and tungsten electrodes were carefully examined under an optical microscope to determine if any scaling or fouling was present. Both electrodes surfaces were found to be free of fouling.

Fig. 15 Discussion of Treatment Time data presented in Fig. 14. Conference proceedings (*ECS Transactions*) on left; journal article (*Journal of The Electrochemical Society*) on right

updated visual such as those in Fig. 14 the same or different from those of recycling the corresponding prose such as that shown in Fig. 15?

Defining Text Recycling

The above discussion lays out the range of practices that might usefully be included under the term "text recycling" and identifies factors likely to be relevant in determining whether any specific occurrence would be judged as acceptable or not. Given both the range and complexity of these factors, constructing an accurate and comprehensive definition of text recycling is challenging. To illustrate these challenges, let us examine one widely circulated definition, that given in the BioMed Central/COPE "Text Recycling Guidelines" (BioMed Central 2013):

> Text recycling, also known as self-plagiarism, occurs when sections of the same text appear (usually un-attributed) in more than one of an author's own publications.

In light of the issues discussed above (and with the acknowledgement that this definition is offered in the context of a guide for journal editors rather than authors), there are a number of issues to be noted:

- "an author's own": As discussed above, only a small proportion of texts produced in the context of STEM research are single-authored. Use of the singular—*author's*—masks an entire set of authorship-related complications that face most practicing researchers and editors.
- "sections" of text: Whether *section* here is interpreted to mean the major sections of a research paper (i.e., Introduction, Methods, and so on) or merely as passages of text, text recycling in practice often involves a scattered distribution of material that we would not describe as a "section."
- *"same"*: One of the challenges of defining text recycling involves determinations of what constitutes legitimate paraphrase (Moskovitz 2017). If an author merely rearranges clauses or sentences and substitutes a few synonyms, the text is no longer literally the "same"; such occurrences, however, might reasonably still be considered as acts of recycling.
- "text": The word "text" might be interpreted as meaning prose specifically or any type of textual material including visuals. Because scientists frequently face decisions about recycling diagrams, tables, and other visual materials, these should be included in discussions and guidelines regarding the reuse of materials.
- "un-attributed": Is a citation either necessary or sufficient in determining whether an instance of recycling is appropriate?
- "publications": While debate on text recycling has focused on published work, the contemporary scientific research process includes many genres—any of which might be the source or destination for recycled material. We must also

remember that different disciplines have different norms for what counts as a publication.

Constructing a precise yet useful definition of text recycling is clearly no simple matter.

One of the most challenging issues in composing such a definition is addressing two opposing requirements. One requirement is that the definition be sufficiently capacious so as to accommodate the range of practices described in the above discussion: various conditions of authorship, the full range of relevant genres, visual materials, and insubstantial alterations from the original. The other is that it be sufficiently narrow so as to include neither acts broadly considered to be plagiarism nor artistic repurposing. In composing a definition, care has been taken to distinguish text recycling from other common practices of text reuse: quoting prose, reproducing visual materials, and repurposing.

There is another concern as well: ensuring that the term is interpreted as ethically neutral. Given that "text recycling" and "self-plagiarism" are often used as synonyms, and also that "self-plagiarism" is sometimes used to label only practices deemed unethical or "transgressive" (Chandrasoma et al. 2004), readers who would encounter the definition outside of the context of the present discussion might thus assume that this term is also derogatory. The proposed definition thus includes a statement on the term's ethical neutrality.

Taking into account the various factors identified in this essay and the concerns just raised, the following definition of text recycling is offered:

> Text recycling is the reuse of textual material (prose or visuals) from one document in a new document where (1) the material in the new document is identical to that of the source or substantively equivalent in both form and content; (2) the material serves the same rhetorical function in both documents; and (3) at least one author of the new document is also an author of the prior document (unless the source contains a statement explicitly granting permission for its contents to be recycled). Quoted prose is distinguished from recycled prose by the syntax of quotation—quotation marks or block indentation. Reproduced (borrowed) visuals are distinguished from recycled visuals by the presence of a statement acknowledging that the materials have been reproduced. Whether any instance of text recycling is deemed appropriate or inappropriate, preferable or undesirable depends on a number of interrelated factors including the genre, context, and authorship of the source and the new document; the amount and nature of the reused material; and whether the new document cites the source or explicitly identifies the recycled material—all of which are judged according to the conventions of the discourse community for which the document is produced.

Readers may notice that this definition excludes two situations discussed above: One is where authors of the new text belong to the same research group as the authors of the source text but for which there is no overlap in authorship (Case 5 in Authorship). The other is the reuse of material from descriptions of databases,

which may be common practice in some social science fields. These exclusions are intentional, since there did not seem to be a logically robust way to distinguish these practices from plagiarism. Given the need to clearly delineate text recycling from plagiarism and the rarity of these situations, this seemed a fair accommodation. Both situations can, however, be brought into accord with this definition. For the former, those directing teams with highly fluctuating membership can consider authoring as a research group, following the example of the STS,S Partnership. For the latter, if those who craft information presenting new databases to the scientific community wish to allow their material to be recycled, they might include an explicit statement of permission such as that of Harris (2007).

Given that a number of professional scientific societies have stated that text recycling is acceptable practice in some situations, there appears to be no avoiding its inherent complexities—which means developing a more nuanced, context-sensitive understanding of the practice. But while the number of published guidelines, editorial statements and letters to the editor has grown rapidly over the past decade, little actual research on text recycling has been conducted and the research that has been done has focused primarily on quantifying the frequency of recycling (Bretag and Carapiet 2007; Higgins et al. 2016).[8] Many of the factors discussed here have yet to be thoroughly considered—either empirically or theoretically.

Such research is essential for shaping the more expansive guidelines that are needed to serve the various constituencies in STEM research and publishing communities. Editors and others involved in the publishing process are the most obvious—and they will clearly benefit from a more robust understanding of these issues. But equally important are the authors—both professionals and students. To date, professional authors have been offered only the most cursory guidance regarding text recycling, and even less is available for students. It is hoped that in addition to helping the STEM community better understand the nature of text recycling, this essay may be of use to those who undertake scholarly investigation.

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[8] An additional paper on text recycling (Horbach and Halffman 2017) was published as the present article was undergoing revision. This paper is limited, in this author's view, in its approach to text recycling as inherently problematic, framing the practice as "academic misconduct" and "a new way to game the reward system of science" rather than as a neutral practice that can be used either properly or improperly. Nevertheless, it is a valuable contribution to the limited scholarship to date.

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